REMARKS

Claims 1-5 and 7-46 remain in the application. Independent Claim 1 is amended to include therein the limitations of Claim 6, which is accordingly canceled.

The Examiner is correct in his assumption that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made.

Claims 1-3, 5-8, 10-13, and 21-23 are rejected under 35 USC 103(a) as being unpatentable over Kikuchi et al (U.S. Patent 6,379,572) in view of Hatakeyama et al (U.S. Patent 6,010,831). Claim 6 is canceled.

Kikuchi et al disclose a method for manufacturing a flat panel display in which a baseplate has a conductive row electrode deposited on it followed by an insulator. A conductive gate electrode is deposited over the insulator and a soft mask material is deposited over the conductive gate electrode. Microspheres are deposited on the soft mask material and an isotropic etch uses the microspheres as a mask to etch the soft mask material to form soft mask portions under the microspheres. The microspheres are removed and a hard mask material is deposited over the soft mask portions. The hard mask material is process and chemical mechanical polished down to the soft mask portions which are removed by etching to leave a hard mask which is used by anisotropic etch process to form gate holes in the gate electrode. The gate holes are used to form emitter cavities into which emitters are deposited.

Hatakeyama et al disclose an ultra-fine microfabrication method using an energy beam based on the use of shielding [masking] provided by nanometer or micrometer sized microparticles to produce a variety of three-dimensional fine structures which, purportedly, have not been possible by the traditional photolithographic technique which is basically designed to produce two-dimensional structures. When the basis technique of radiation of an energy beam and shielding is combined with a shield positioning technique using a magnetic, electrical field, or laser beam, with or without the additional chemical effects provided by reactive gas particle beams or solutions, fine structures of very high aspect ratios are purportedly produced with precision. Applications of devices having the fine structures produced by this method are said to include wavelength shifting in optical communications, quantum effect devices, and intensive laser devices.

Applicants' amended Claim 1 recites a method for forming at least one nanopore for aligning at least one molecule for molecular electronic devices or for forming a mold for deposition of a material. The method comprises:

(a) providing a substrate having a first major surface and a second major surface, substantially parallel to the first major surface;

(b) forming an etch mask on the first major surface, the etch mask comprising at least one nanoparticle;

(c) directionally etching the substrate from the first major surface toward the second major surface, using the etch mask to protect underlying portions of the substrate against the etching, thereby forming at least one pillar underneath the etch mask, wherein the directional etching is carried out by reactive ion etching;

(d) forming a layer of insulating material on the etched substrate, including around the pillar(s) and at least partially covering the pillar(s); and

(e) removing the pillar(s) to leave at least one nanopore in the insulating layer.

The Examiner essentially argues that the process of Kikuchi et al, which is directed to making microscale holes, could be modified by the process of Hatakeyama et al, which is directed to making pillars of nanoscale size. Applicants note that, in point of fact, the process of Hatakeyama et al is directed to making cones, not pores, which are suitably used as field emitter tips.

The Examiner appears to be suggesting that a process for making microscale pores can be combined with a process for making solid nanoscale cones, and that this combination somehow discloses Applicants' method for forming nanopores for aligning at least one molecule for molecular devices or for forming a mold for deposition of a material therein.

Applicants understand that the Examiner is relying on a part of the process of Hatakeyama et al, namely, that depicted in Figures 2A-2C, in combination with the process of Kikuchi et al, to suggest that the microscale process of Kikuchi et al could be conducted using the nanoscale process of Hatakeyama et al.

However, as the Examiner admits, Kikuchi et al do not teach the use of reactive ion etching. The Examiner relies on Hatakeyama et al for the alleged teaching of RIE, based on their statement in the Abstract of an "energy beam with reactive gas particle beam". However, as noted throughout the reference, the energy beam is a "fast atomic beam (FAB)"; see, e.g., Col. 4, lines 65-67. Hatakeyama et al further discuss the use of gaseous particles of chlorine or fluo-

rine, "which are reactive with the target object" (Col. 5, lines 24-39). A fast ***atomic*** beam is not the same thing as reactive ***ion*** etching, and the use of FAB hardly discloses or suggests the use of RIE. Claim 1 has been amended to incorporate the limitations of Claim 6 regarding the use of RIE to directionally etch the substrate.

In this connection, it is noted that Hatakeyama et al describe their use of energy beam-assisted ultra-fine fabrication as a two-step process: (1) the etching process is done by energy beam radiation, followed by (2) etching with chemically reactive gaseous particles or in a chemical solution (Col. 2, lines 27-31). As described in Col. 12, lines 31ff:

> "The FAB 93 is generated from an argon gas FAB source 97 ... and comprising a discharge space formed by two (or three) flat-plate type electrodes 95, 96 contained in a housing 94 and introducing argon gas into the discharge space. The argon FAB source 97 produces an argon plasma in the discharge space by impressing a high voltage between both electrodes 95 and 96. The ionized gas particles are attracted to the negative electrode 96, where they collide with the gas molecules and combine with electrons to transform into fast atomic particles. The *neutral* particles are discharged from a discharge port in the negative electrode to provide a *neutral* fast particle beam." (emphasis added.)

The patentees continue in Col. 12, lines 53ff:

> "Because the FAB 93 emitted from the FAB source 97 is an electrically *neutral* beam, it is not affected by charge accumulation or electrical or magnetic fields, and exhibits superior linearity." (emphasis added.)

Clearly, Hatakeyama et al draw a distinction between their FAB, using ***neutral*** species, and other approaches, using, for example, ***ionic*** species. The distinction is even clearer when it is recalled that reactive ion etching involves immersion of the sample being etched in a ***plasma of ions,*** whereas FAB, as plainly described by Hatakeyama et al, involves a ***beam of neutral atomic particles***. This distinction is further supported by two references cited on the front page of the Hatakeyama et al patent, namely, Fusao Shimokawa et al, "Reactive-fast-atom beam etching of GaAs using Cl_2", Journal of Applied Physics, Vol. 66, No. 6, pp. 2613-2618 (15 September 1989) and Massahiro Hatakeyama et al, "Fast Atom Beam Source", U.S. Patent 5,216,241, issued June 1, 1993. A copy of both references is provided for the convenience of the Examiner. However, an Information Disclosure Statement and accompanying fee under 37 CFR 1.17(p)

are not required in this instance, since these two references are being cited, not as prior art, but as clarifying the distinctions between FAB and RIE.

Based on the foregoing discussion, the disclosure of a beam of neutral atomic particles to etch a sample does not even remotely suggest the use of a plasma of ions to etch a sample, and the combination of the two references, fairly considered, fails to disclose or suggest Applicants' Claim 1 as amended.

Reconsideration of the rejection of Claims 1-3, 5, 7-8, 10-13, and 21-23, as amended, under 35 USC 103(a) as being unpatentable over Kikuchi et al in view of Hatakeyama et al is respectfully requested.

Claims 9, 14-20, 24-26, and 28-46 are rejected under 35 USC 103(a) as being unpatentable over Kikuchi et al, *supra*, in view of Hatakeyama et al, *supra*, and further in view of Jun (U.S. Patent 5,393,373).

Kikuchi et al and Hatakeyama are discussed above. Jun discloses methods of hyperfine patterning and manufacturing semiconductor devices. The steps include coating a hemisphere particle layer having hills and valleys on a layer to be etched, the hemisphere particle layer having an etch selectivity higher than that of the first layer, filling the valleys of the hemisphere particle layer with a second layer having an etch selectivity higher than that of the hemisphere particle layer, and etching back the hills of the hemisphere particle layer to expose the first layer by using the second layer as a mask, and etching the first layer. By virtue of the hemisphere particle layer having alternating hills and valleys, it is purportedly possible to accomplish a hyperfine patterning of about 0.1 μm.

The Examiner argues that Jun et al teach depositing insulation material by CVD (relevant to Applicants' Claim 9) and filling the valleys with material (relevant to Applicants' Claims 14-20).

However, the combination of Kikuchi et al and Hatakeyama et al has been shown above to be flawed, and hence the combination of Kikuchi et al with Hatakeyama et al and Jun et al likewise falls.

With regard to independent Claim 24, that claim recites a method for forming at least one molecule in a pre-selected orientation relative to a substrate. The method comprises:

(a) forming at least one nanopore by:

(1) providing the substrate having a first major surface and a second major surface, substantially parallel to the first major surface,

(2) forming an etch mask on the first major surface, the etch mask comprising at least one nanoparticle,

(3) directionally etching the substrate from the first major surface toward the second major surface, using the etch mask to protect underlying portions of the substrate against the etching, thereby forming at least one pillar underneath the etch mask,

(4) forming a layer of insulating material on the etched substrate, including around the pillar(s) and at least partially covering the pillar(s), and

(5) removing the pillar(s) to leave at least one nanopore in the insulating layer; and

(b) dispersing at least one molecule in each nanopore.

Jun et al are totally silent on the concept of filling their valleys with at least one molecule. The Examiner contends that this reference teaches depositing material in the valleys, which the Examiner equates to Applicants' nanopores. The material (dielectric layer 16 and polysilicon layer 17) is actually used to coat the upper surface of polysilicon layers 24 and 27 to produce a capacitor. A process for depositing a dielectric ***layer*** and a polysilicon ***layer*** in a valley hardly suggests disposing at least one ***molecule*** in a nanopore.

Accordingly, Claim 24, together with Claims 24-26 and 28-46 are clearly patentable over the combination of references.

Reconsideration of the rejection of Claims 9, 14-20, 24-26, and 28-46 under 35 USC 103(a) as being unpatentable over Kikuchi et al in view of Hatakeyama et al and further in view of Jun is respectfully requested.

Claims 4 and 27 are rejected under 35 USC 103(a) as being unpatentable over Kikuchi et al, *supra*, in view of Hatakeyama et al, *supra*, and further in view of Jun, *supra*, and further in view of Brandes et al (U.S. Patent 5,900,301).

Kikuchi et al, Hatakeyama et al, and Jun et al are discussed above. Brandes et al disclose the structure and fabrication of electron-emitting devices utilizing electron-emissive particles which contain carbon.

Applicants' Claim 4 depends from Claim 1 and recites the structure of the nanoparticle(s) used in the method of Claim 1, namely, an inorganic crystalline core covered with an organic layer.

The Examiner argues that Brandes et al teach applying carbon particles for etching and that the particles are applied though an organic solvent.

Applicants have shown above that the combination of Kikuchi et al and Hatakeyama et al falls with respect to amended Claim 1. Accordingly, the combination of Kikuchi et al, Hatakeyama et al, Jun et al, and Brandes et al also falls.

Applicants' Claim 27, which is analogous to Claim 4, depends from independent Claim 24. As shown above, the combination of Kikuchi et al, Hatakeyama et al, and Jun et al utterly fails to disclose or even remotely suggest a method for forming a molecule in a pre-selected orientation relative to a substrate, as recited in Claim 24. Accordingly, the combination of Kikuchi et al, Hatakeyama et al, Jun et al, and Brandes et al also falls.

Reconsideration of the rejection of Claims 4 and 27 under 35 USC 103(a) as being unpatentable over Kikuchi et al in view of Hatakeyama et al and further in view of Jun and further in view of Brandes et al is respectfully requested.

The foregoing amendments and arguments are submitted to place the application in condition for allowance. The Examiner is respectfully requested to take such action. If the Examiner has any questions, he is invited to contact the undersigned at the below-listed telephone number. HOWEVER, ALL WRITTEN COMMUNICATIONS SHOULD CONTINUE TO BE DIRECTED TO: IP ADMINISTRATION, LEGAL DEPARTMENT, M/S 35, HEWLETT-PACKARD COMPANY, P.O. BOX 272400, FORT COLLINS, CO 80527-2400.

Respectfully submitted,

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